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ABSTRACT

Designed to help adult learners realize the importance and necessity of implementing continuous quality improvement (CQI) in a rapidly changing, competitive, and modern world of work, this document presents a comprehensive explanation of CQI. The following topics are discussed in the book's introduction and seven chapters: importance of quality in the workplace; definitions of CQI; W. Edwards Deming's philosophy and teachings about CQI (Deming's 14-point philosophy of CQI and 7 deadly sins interfering with implementation of CQI); the CQI organizational culture (underlying values and beliefs, information utilization to improve quality, employer-employee relationships in the CQI organizational culture, traditional versus CQI management styles); the customer (CQI and past, present, and future customers; CQI and internal versus external customers; the importance of customer satisfaction); establishing CQI standards (process, quality standards, control); statistical process control (role of statistics in statistical process control; use of checklists, cause-and-effect diagrams, flowcharts, histograms, trend charts, control charts, Pareto charts, and scatter diagrams in statistical process control); team building (stages of team development, conflict resolution, feedback, typical team problems and solutions); and six steps in problem solving (identify the problem, gather and analyze the data, analyze and implement the solution, prevent problems). (MN)

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QUALITY ASSURANCE MADE EASY

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INTRODUCTION

The purpose of this book is to present a simple but comprehensive explanation of continuous quality improvement (CQI). CQI is a holistic approach to doing business that touches every part of an organization. The seven chapters are organized as follows:

The first three chapters discuss the background, philosophy, and teachings of Dr. W. Edwards Deming, who developed a CQI culture that prioritized continuous improvement of products. The next chapter presents a brief account of quality standards and how they are brought under control. The chapter on Statistical Process Control (SPC) illustrates some tools used to gather scientific data for solving problems associated with quality improvement.

Because teams are key to the success of implementing CQI techniques, a chapter is devoted to the principles of team building. Within the team structure, members analyze data collected from the statistical process control tools. The final chapter outlines six steps of problem solving necessary for more effective decision making.

The author's goal in writing this book is for adult learners to realize the importance and necessity of implementing continuous quality improvement in a rapidly changing, competitive, and modern work world.

Lorry Villemaire
Author

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WOULD YOU HIRE EMPLOYEES WHO PERFORM 90% QUALITY WORK?

Without much thought given to this question, most people would answer, "Yes, I'd hire employees who do 90% quality work." However, in thinking more deeply about this question, it means that workers who perform quality work 90% of the time are not reliable the remaining 10% of the time. Let's rephrase the question. Would you like the computer in a large city bank to operate 90% of the time? Would you like your car to drive only 90% of the time? Would you like your microwave oven (or refrigerator, stove, television, etc.) to work 90% of the time? Would you fly in an airplane that is 90% dependable? Would you like to test the plane's reliability when it is twenty thousand feet in the air?

What happens to quality work when three employees perform well 90% of the time? A simple math example answers that questions.

MULTIPLY THE QUALITY WORK OF WORKER 1 AND WORKER 2.
90% X 90% = 81%

MULTIPLY WORKER 3 WITH THE QUALITY WORK OF WORKERS 1 AND 2
90% X 81% = 72.9%

THE QUALITY WORK HAS LESSENED TO ABOUT 73%

THE GREATER THE NUMBER OF 90% QUALITY WORKERS,
THE SMALLER THE PERCENT OF QUALITY WORK.

This math example shows how important it is to have employees who are dependable and committed to quality performance. A business is only as good as the total reliability of all its members.

Manufacturers' understanding of quality has changed and grown over the last forty or fifty years. Prior to that time, quality work was judged by how well products were made and services rendered. Quality was measured by inspection when products came off the assembly line, but only AFTER they were made. Products with errors were sent back to be corrected, reworked, or scrapped. The fewer the errors, the greater the quality of the product. There was not much scientific thought about what went into the step-by-step process that produced a product or rendered a service.

However, people recognized quality when it happened. For example, customers knew when restaurant food was delicious, when clothing was made of the most durable materials, when automobiles ran efficiently, when books were well written, when music was professionally played, when costs were reduced, and services improved.

In time, manufacturers realized that the traditional method of inspecting products AFTER they were made was too time consuming and not cost effective. They felt quality could be scientifically measured on a continuous basis. They questioned former quality standards and asked some serious questions like:

1. What is quality?

2. Are there ways to set quality goals BEFORE making a product or performing a service?

3. Are there ways to prevent errors PRIOR TO completion rather than pick up the pieces at the end?

4. Are there ways to catch errors DURING the manufacturing process?

5. Are there scientific tools that could be used to measure quality in an ON-GOING manner?

6. Are there ways to set a standard or an average for normal distribution of goods?

Engineers investigated new ways to measure quality and developed what is known today as continuous quality improvement or CQI.

THE MEANING OF CONTINUOUS QUALITY CONTROL

Continuous quality improvement has a variety of meanings. Webster's dictionary defines continuous as ongoing, quality as a degree of excellence, and improvement as making something better. According to Webster, CQI is a process that continually enhances excellence.

In a book titled Implementing TQM, Joseph Jablonski defines CQI as, "a cooperative form of doing business that relies on the talents and abilities of employees and managers to continually improve quality and productivity by using team."

There are three factors to consider in Jablonski's definition. First, for CQI to succeed, employees and managers must cooperate in using their talents and abilities to improve quality. The cooperative effort and total commitment of everyone in the business organization are absolutely necessary. Secondly, quality improvement is a continuous, ongoing process. Thirdly, teams are the structures in which employees and managers gather to work on quality production and services.

Sashkin and Kiser, in their book Total Quality Management, say that there are three "C" words that describe CQI: counting, customer, and culture. Counting refers to the tools, techniques, and training required to understand, analyze, and solve problems. The customer is the person who purchases the products or services. Culture refers to the values and beliefs that identify and support the CQI process.

Sashkin and Kiser define CQI as, "the use of statistical tools, techniques, and training to continually improve customer satisfaction by encouraging and supporting the commitment of all organizational members toward that end."

THE DEMING PHILOSOPHY

HISTORICAL DEVELOPMENT OF CONTINUOUS QUALITY IMPROVEMENT

There are many people who developed and contributed to the study of CQI. Among them are Philip Crosby, Walter A. Shewhart, Dr. Joseph M. Juran, and Dr. W. Edwards Deming. The focus of this book is mainly on the work of Dr. Deming, since he is regarded as the founder of the new economic industrial era.

Deming received his Doctorate in Statistics from Yale University. His methods of determining quality were very popular in the 1930's and 1940's, particularly in the production of war products needed during World War II. Japanese engineers were amazed at the quality of U. S. military equipment captured during the war.

A critical industrial shift took place in the United States after the War. There was a great demand for consumer goods. Americans wanted to make up for the materials they lacked during the war. Because foreign countries had to rebuild their own industries damaged by war, the post-war years were a prosperous field day for United States industries. Workers in the lower levels of industries were very interested in making quality products. However, management got more caught up in mass production (quantity) because they reaped high profits. The downside of mass production was the company's loss of interest in quality production.

On the other hand, Japan knew it had to make major changes if it was to compete in the world market. At that time, "Made in Japan" was considered inferior. Japanese leaders invited Dr. Deming to show them how to make quality products.

Deming did not want to repeat in Japan what happened in the United States. Deming insisted on the total support of management in order to create a climate or a "culture" for CQI to succeed. The most important factor that Deming introduced in Japan was that it was absolutely necessary for management to support and become leaders in the quality improvement process.

Managers in Japan applied Deming's methods of quality improvement and built a strong industrial base. By the 1960's and 1970's, quality improvement was in full swing. If anyone wanted quality products, they bought them from Japan. History has proven the success of Deming's philosophy in the Japanese marketplace.

In more recent years, the United States, as well as many other countries around the world, has returned to the principles of continuous quality improvement. The world market is very competitive. Companies must produce quality products and services if they wish to stay in business. The success or failure of a company seems to rest on the implementation of a solid quality assurance program.

DEMING'S 14 POINTS

The CQI philosophy is summarized in what is known as Deming's 14 Points.

1. CREATE CONSTANCY OF PURPOSE FOR IMPROVEMENT OF PRODUCT AND SERVICE.

Improving products is the main purpose of a business. Profits, jobs, and competition are the results of placing quality first.

2. ADOPT A NEW PHILOSOPHY.

Adopting a new philosophy is the opposite of "business as usual." Society is in a new economic age that requires new ways of thinking and accepting the fact that there are other and better ways of doing things.

3. CEASE DEPENDENCE ON INSPECTION TO ACHIEVE QUALITY.

Inspecting products after they are made give the appearance that workers are paid to make errors. Quality must be built into the product from the start.

4. END THE PRACTICE OF AWARDING BUSINESS ON PRICE ALONE.

Placing profit first is to put the cart before the horse. Price has meaning only in relationship to quality. Quality must be a greater value than profit.

5. IMPROVE CONSTANTLY AND FOREVER EVERY PROCESS FOR PLANNING, PRODUCTION, AND SERVICE.

Discovering ways to improve quality and cut costs are never ending responsibilities.

6. INSTITUTE TRAINING AND RETRAINING ON THE JOB.

Train workers on how to do the jobs for which they are responsible and how to use statistical data to improve quality on an ongoing basis.

7. INSTITUTE LEADERSHIP.

Leadership must exist on all levels of the organization in order to create an environment for CQI to succeed.

8. DRIVE OUT FEAR.

Quality performance is possible only in an environment of trust, openness, and honesty. When people are afraid, they fail to speak up, identify problems, or ask questions.

9. BREAK DOWN BARRIERS AMONG STAFF.

Every member of the workplace has to work together in order to achieve common goals.

10. ELIMINATE SLOGANS AND PEP TALK.

Employees need the support of management and the tools to improve quality. Empty words are not motivating factors.

11. ELIMINATE NUMERICAL QUOTAS.

Focus on quality, not quantity. People are more apt to write down any random numbers to show quotas are reached. Numbers encourage dishonesty.

12. REMOVE BARRIERS TO PRIDE IN WORKMANSHIP.

Start with the positive attitude that most employees want to do quality work. People do not respond well when judged or criticized. Rather than concentrate on merit or rating systems, provide workers with quality materials, equipment, and training to help them to feel pride in their work.

13. INSTITUTE A PROGRAM OF EDUCATON AND SELF-IMPROVEMENT.

Education includes more than learning about quality assurance tools. It means news ways of working together as a team to support a CQI environment.

14. PUT EVERYONE TO WORK TO ACCOMPLISH A CQI TRANSFORMATION.

Everyone in the organization is responsible for implementing quality.

SUMMARY OF DEMING'S 14 POINTS

1. CREATE CONSTANCY OF PURPOSE FOR IMPROVEMENT OF PRODUCT AND SERVICE.
2. ADOPT A NEW PHILOSOPHY.
3. CEASE DEPENDENCE ON INSPECTION TO ACHIEVE QUALITY.
4. END THE PRACTICE OF AWARDING BUSINESS ON PRICE ALONE.
5. IMPROVE CONSTANTLY AND FOREVER EVERY PROCESS FOR PLANNING PRODUCTION AND SERVICE.
6. INSTITUTE TRAINING AND RETRAINING ON THE JOB.
7. INSTITUTE LEADERSHIP.
8. DRIVE OUT FEAR.
9. BREAK DOWN BARRIERS AMONG STAFF.
10. ELIMINATE SLOGANS AND PEP TALKS.
11. ELIMINATE NUMERICAL QUOTAS.
12. REMOVE BARRIERS TO PRIDE IN WORKMANSHIP.
13. INSTITUTE A PROGRAM OF EDUCATION AND SELF-IMPROVEMENT.
14. PUT EVERYONE TO WORK TO ACCOMPLISH A CQI TRANSFORMATION.

DEMING'S SEVEN DEADLY SINS

Deming knew that implementing his 14 Points was no easy task. He believed that "Seven Deadly Sins" interfered with implementing CQI.

1. LACK OF PURPOSE

Rather than concentrate on new products or services, the focus was on survival. The main concern was to make money.

2. EMPHASIS ON SHORT-TERM PROFITS

The priority was to make things look good and bring in profits.

3. MANAGEMENT BY OBJECTIVES AND EVALUATION

Management consisted of competition, negative criticism, employee control, and looking out for oneself rather than the good of the whole facility.

4. MOBILITY OF MANAGEMENT

Managers changing jobs do not develop roots, lessening loyalty to the organization.

5. USE OF VISIBLE FIGURES ARE ONLY FOR MANAGEMENT.

What was the purpose of the data and what did it mean?

6. EXCESSIVE MEDICAL COSTS

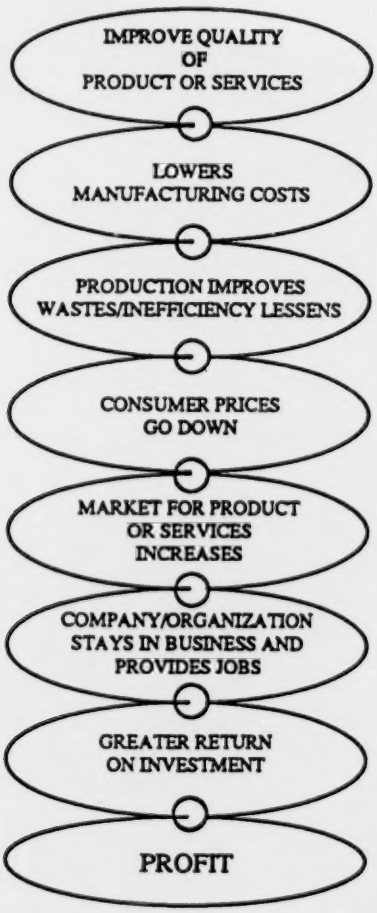
Medical care at best was very expensive.

7. EXCESSIVE LIABILITY COSTS

Lawyers' fees were due to accidents and other health issues.

DEMING'S CHAIN REACTION

Deming maintained that improving products while they were made reduced the number of mistakes, defects, breakdowns, delays, inefficiencies, and costs. It saved the company a considerable amount of money, which in turn lowered consumer costs. Lower costs created a greater demand for goods or services. The result of this domino effect or chain reaction resulted in higher profits and more secure jobs.


IMPROVE QUALITY OF PRODUCT OR SERVICES
LOWERS MANUFACTURING COSTS
PRODUCTION IMPROVES WASTES/INEFFICIENCY LESSENS
CONSUMER PRICES GO DOWN
MARKET FOR PRODUCT OR SERVICES INCREASES
COMPANY/ORGANIZATION STAYS IN BUSINESS AND PROVIDES JOBS
GREATER RETURN ON INVESTMENT
PROFIT

THE CQI ORGANIZATIONAL CULTURE

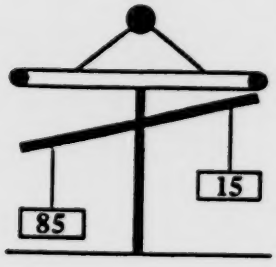
VALUES AND BELIEFS OF THE CQI ORGANIZATIONAL CULTURE

A primary component of Deming's philosophy is the CQI organizational culture. This culture is of utmost importance if continuous quality improvement is to succeed. Culture is defined as the beliefs, values, and visions that are shared by all members of the organization. The culture shapes the new way of doing business. What follows are some of the values that go into developing a CQI culture.

INFORMATION IS USED TO IMPROVE QUALITY, NOT CONTROL INDIVIDUALS

Many people in the workplace grew up with the idea that the individual worker was blamed for most of the problems that occurred on the job. Deming pointed out that workers were responsible for less than 15% of problems that arose on the job, while 85% of mistakes came from the PROCESS of how things were done. Deming called this theory the 85/15 rule. Obviously, the causes of problems fell heavier on the side of systems rather than individuals. To correct the problem, employees at all levels would have to look at the steps within the process itself.

PROCESS



WORKERS

EMPLOYEES SHOULD BE EMPOWERED AND CONSULTED ABOUT THE WORK FOR WHICH THEY ARE RESPONSIBLE

Many managers fear the word "empowerment" because they feel it means giving up their own power or control. Under CQI management, power and control are not lost but shared. Empowerment is a different way of doing business. It is finding a balance between individual freedom and management control. Empowerment is doing and acting responsibly. All persons are involved and consulted about matters that pertain to their respective work areas. An empowered culture is a workplace in which teams of people work together to get the job done right.

REWARD GOOD RESULTS

Rewards are real ways of conveying that quality performance on the job has value. Deming cautions people, however, that rewards also encourage competition among workers. Rather than perform for the good of the whole, employees compete with each other for personal praise or advancement. One way to avoid this trap is to present rewards for improving quality performance standards. An example of a reward is profit sharing that results from quality improvement standards generated by individuals or groups.

THE BASIS FOR WORKING TOGETHER IS COOPERATION

The main reason for working together is cooperation, not competition. Employees must be concerned about the good of the entire organization and not of

the attitude that every person is out for oneself. One way to build a cooperative spirit among employees is to design self-managing teams. The advantage of self-managing teams is that it shifts the focus from the individual worker to the knowledge, experience, and loyalty of each member of the team.

EMPLOYEES ARE MORE APT TO SUGGEST QUALITY IMPROVEMENT IF THEY FEEL SECURE IN THEIR JOBS.

Fear of making mistakes or losing one's job lowers employees' morale. If jobs are at risk, employees aren't interested in finding new ways to cut costs or improve products. Managers at all levels should do everything possible to help employees succeed. The best way to improve quality and cut costs at the same time is to focus on quality performance.

THE ORGANIZATIONAL ENVIRONMENT IS ONE OF FAIRNESS AND JUSTICE.

Fairness is one of the most important parts of the CQI culture. It is impossible for workers to cooperate if they are not treated justly. Some practical suggestions on how to act fairly are:

- Do what you say you will do.
- Share useful information.
- Avoid lying or giving false impressions.
- Be clear on what is expected from employees.
- Show concern for others.
- Keep confidences.
- Avoid favorites or special treatment of one employee over another.
- Invite employees to share in the decision that affect their work.
- Recognize employees' strengths, gifts, and contributions.

A positive and caring environment lessens medical costs, sickness, tardiness, absenteeism, legal fees, accidents, and compensation costs.

SALARIES SHOULD BE FAIR.

Some economists believe that executives should earn no more than 20 times the pay of the lowest-paid worker. In most large corporations, executives are paid 50 to 100 times more. This practice makes fairness more difficult to achieve. Managers should try to make some adjustment so that there isn't such a large gap between the salaries of executives and other employees.

OWNERSHIP IN AN ORGANIZATION IS SHARED.

Employees exhibit greater commitment to the organization when there is some amount of ownership. Whether through profit sharing, stock options, or shared decision-making, the important thing to remember is that employees must feel a sense of responsibility and accountability for their work.

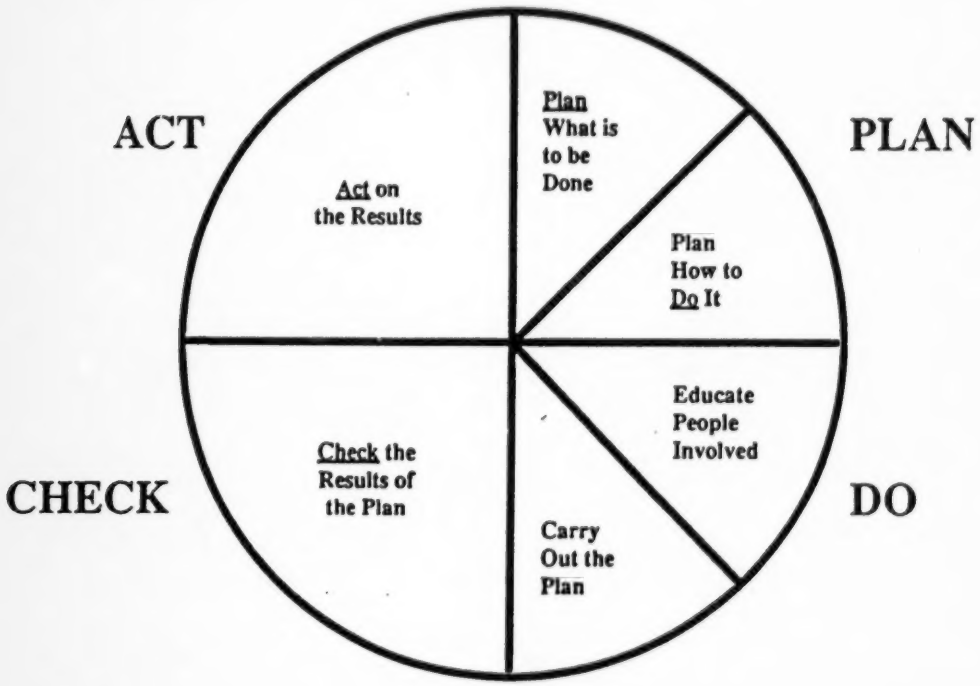
IMPROVING QUALILTY IS A CONTINUOUS PROCESS.

Deming believed there are four continuous steps to improving quality:

1. PLAN carefully what must be done.
2. DO or carry out that plan.
3. CHECK the results of the plan.
4. ACT with appropriate actions.

The final results of these actions, whether successful or not, must be analyzed. Even good results can be improved. That is why the cycle goes on and on with

quality improving continuously. The diagram below graphically demonstrated Deming's four parts to improve quality.



TRAIN AND EDUCATE EVERYONE IN CONTINUOUS QUALITY IMPROVEMENT.

CQI requires a new way of thinking that involves change. Change at best is difficult and slow. Employees or managers who have been working in a certain way for years are very reluctant to change. They fear the unknown. The best way to drive out fear is to educate and train EVERYONE so that transition can be made smoothly. One way to understand the transition to a CQI culture is to compare it with the traditional management style used in the past.

COMPARISON OF TRADITIONAL AND CQI MANAGEMENT STYLES

	TRADITIONAL	CQI
•	Focused on product.	Focuses on customer satisfaction.
•	Encouraged competition, blame dishonesty, and fear.	Encourages quality work for the good of the whole.
•	Based goals on guesswork and assumptions.	Establishes goals on scientific data.
•	Interested in meeting quotas.	Interest is on quality products.
•	Determined errors by inspection.	Works on preventing errors before they occur.
•	Educated only top managers.	Educates and trains all employees.
•	Thought in terms of short-range goals.	Thinks in terms of long-range goals.
•	Checked quality after product was made.	Establishes quality standards before product is made.
•	Managers and employees worked independently.	Managers and employees work in teams.
•	Workers feared job loss if quotas weren't made.	All persons work together to meet quality standards.
•	Customers were buyers.	Customers decide quality.
•	95% quality was acceptable.	100% quality is the goal.

A SUMMARY OF VALUES AND BELIEFS THAT CREATE A CQI CULTURE

- INFORMATION IS USED TO IMPROVE QUALITY AND NOT TO CONTROL INDIVIDUALS.
- EMPLOYEES SHOULD BE EMPOWERED AND CONSULTED ABOUT THE WORK FOR WHICH THEY ARE RESPONSIBLE.
- REWARD GOOD RESULTS.
- THE BASIS FOR WORKING TOGETHER IS COOPERATION.
- EMPLOYEES ARE MORE APT TO SUGGEST QUALITY IMPROVEMENT IF THEY FEEL SECURE IN THEIR JOBS.
- THE ORGANIZATIONAL ENVIRONMENT IS ONE OF FAIRNESS AND JUSTICE.
- SALARIES SHOULD BE FAIR.
- OWNERSHIP IN THE ORGANIZATION IS SHARED.
- IMPROVING QUALITY IS A CONTINUOUS PROCESS.
- TRAIN AND EDUCATE EVERYONE IN CONTINUOUS QUALITY IMPROVEMENT.

THE CUSTOMER

Most people believe that profit is the bottom line of business. One of the most important components of Deming's philosophy is that customer satisfaction is the bottom line. Deming believed that when products had quality, profits fell into their proper place.

Customers have to feel confident that a product or service meets or exceeds their needs at all times. Most customers complain when they don't like a product or service. Quality is what the customer wants. Without customer satisfaction, there is no business.

Constructive complaints and honest feedback from customers give clues when something is wrong with a product. On the other hand, there are customers who don't complain at all. They quietly go to another company to buy what they need. CQI involves different types of customers: past, present, future, internal, and external.

PAST CUSTOMERS

These are the people the organization wishes to REGAIN.

PRESENT CUSTOMERS

These are the people who purchase products or services NOW and those for whom the organization continually strives to satisfy.

FUTURE CUSTOMERS

These are the people the company hopes to GAIN.

INTERNAL CUSTOMERS

Internal customers are employees who receive or give work to one another within the SAME organization. Also included are people who receive the services of employees, as in the case of residents in a nursing home. It is often harder to satisfy internal customers because they are seen again and again throughout the day.

EXTERNAL CUSTOMERS

External customers are consumers who financially support the organization by purchasing products or services. External customers are also people who sell products or services outside the organizaiton.

CUSTOMER SATISFACTION IS THE MOST IMPORTANT PART OF THE ORGANIZATION'S CULTURE

Products and services must be improved again and again because customers' needs change, supplies become scarce with greater use, or competition among businesses increase. There is a lot of competition in the world market today. Companies that survive are the ones whose main concern is customer satisfaction above all else.

ESTABLISHING QUALITY STANDARDS

Deming felt that inspection alone did not improve quality. He believed quality was improved by establishing STANDARDS and CONTROLLING them during the manufacturing PROCESS.

PROCESS

A process is a series of step-by-step activities directed toward a particular outcome. Each step in the process is performed in sequence and affects all the other steps. By understanding the start, the end, and everything that happens in between, manufacturers can detect and control problems as they occur.

QUALITY STANDARDS

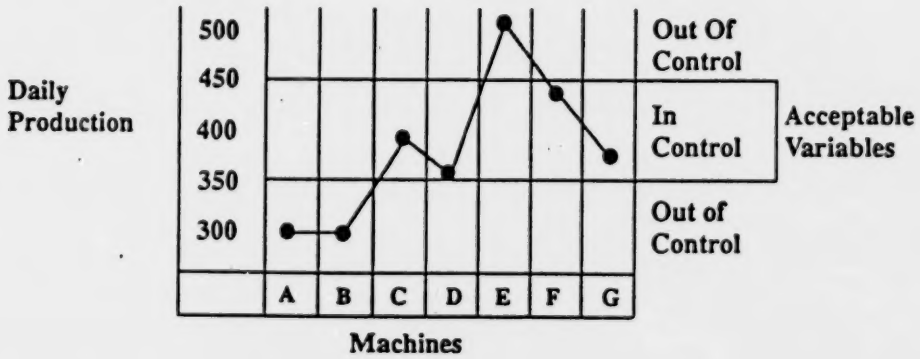
To control quality, standards are established for each step in the process. Standards are used to make judgments about the quality of the product. Products are acceptable when they conform to quality standards. The closer products come to meeting standards, the greater the quality. Quality is continuously improved by raising the standards.

CONTROL

Since nothing is perfect, multiple factors like defective materials, broken equipment, delays, human error, weather, lack of efficiency, and poor environment, cause variations in the quality of products. Consequently, there must be levels of acceptable variables built into quality standards. These acceptable variables form the minimum and maximum quality value of a product. The minimum value is called

lower control limit (LCL). The maximum value is called upper control limit (UCL). Standards that fall between LCL and UCL levels are referred to as "being in control." Standards that fall outside these levels are "out of control". The task of the quality assurance process is to bring non-acceptable variations under control.

The data shown on the chart below lists the number of products made by Machines A to G. Acceptable variable levels are set between 350 and 450. From the statistical data shown in the chart, questions regarding quality arise. Why are Machines A, B, and E out of control? What needs to be done to bring them into control? Why are Machines C, D, F, and G successful? Can their success be applied to the other machines?



The diagram above is called a control chart and is one of many tools used to gather statistical data for the purpose of establishing quality standards. Other features that are important in improving quality standards are to:

1. Meet and exceed customer expectations and satisfaction.
2. Come as close as possible to error-free defects.

3. Be planned and agreed upon by all persons concerned.
4. Be supported by management.
5. Be communicated effectively and taken seriously.
6. Be workable and understood.
7. Be followed and changed as needed.
8. Be measured and compared against the outcome.
9. Be part of the total organizational plan for improvement.
10. Be part of an educational program on how standards can be implemented.
11. Be continuously improved.
12. Be celebrated or rewarded when achieved.

The science of using multiple tools and equipment for the purpose of establishing quality standards is call Statistical Process Control (SPC) and is the title of the next section.

STATISTICAL PROCESS CONTROL

(SPC)

STATISTICAL PROCESS CONTROL (SPC)

Statistical process control or SPC is a data-based or scientific approach to quality. It is the backbone that helps create a climate of excellence. This means that every step in the production process is studied and brought under control by means of gathering statistics. Statistics is the science that uses numbers, facts, and data for the purpose of solving problems and improving quality. Statistics are used to:

IDENTIFY PROBLEMS

HELP UNDERSTAND THE ACTUAL SITUATION

ELIMINATE DEFECTS AND ERRORS

PROVIDE DATA FOR ANALYSIS AND DECISION MAKING

BRING OPERATING PROCESS UNDER CONTROL

IMPROVE THE WORKING PROCESS

Statistics are gathered, organized, and recorded on statistical tools. Statistical tools are charts, graphs, and diagrams that visually show when things aren't working as well as expected.

There are many types of statistical tools. The choice of which tool to use depends on the project under study. An explanation of the most commonly used statistical tools are explained in the following pages.

CHECKLIST OR CHECKSHEET

MEANING The checklist is a simple tool that shows how often an event is happening. It helps turn opinions into facts. It is a structured form that makes data easy to read and analyze.

USAGE The checklist records different conditions like patterns of error, operations as they occur, days production, inventory, etc.

EXAMPLE 1

ERRORS	TALLY	TOTAL
Late Deliveries	𝍸 ||	7
Damaged Goods	||	2
Incomplete Orders	𝍸 𝍸 𝍸	15
TOTAL:		24

EXAMPLE 2

	Bill	John	Mary	Sue	Pat	Jim
MON	✓		✓	✓		✓
TUES	✓	✓				✓
WED	✓		✓		✓	
THURS	✓			✓		
FRI	✓			✓		✓

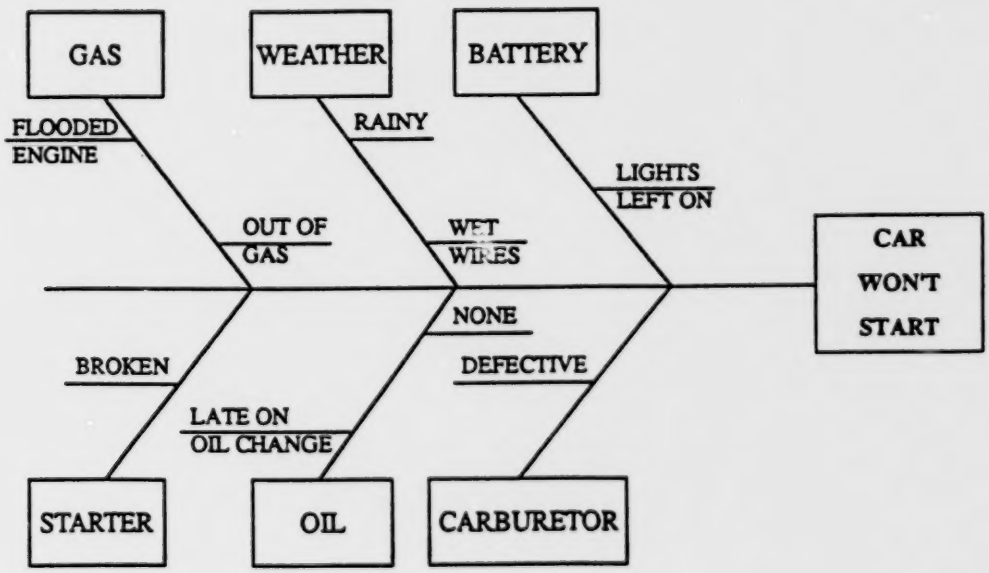
CAUSE AND EFFECT DIAGRAM - FISHBONE

MEANING A schematic diagram showing root causes and effects of a specific problem.

A diagram that shows the causes of an outcome or event.

USAGE The cause and effect diagram is useful in identifying the problem and its source.

EXAMPLE



FLOWCHART

MEANING A picture that shows steps in a process.

A picture used to plan stages of a project.

A picture describing a process being studied.

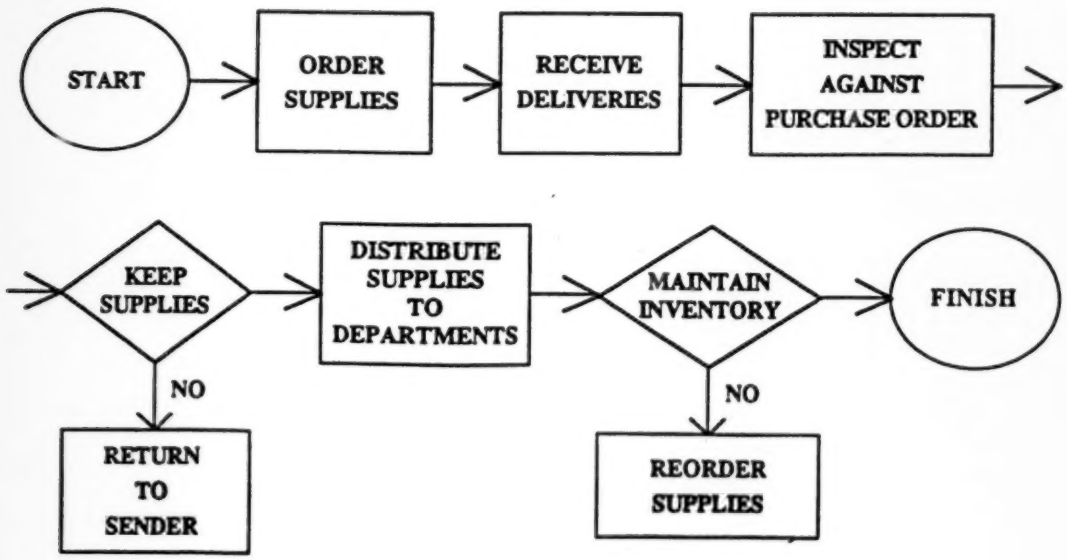
USAGE A flowchart helps to show how things are done, identify problems or simplify the process, and eliminate unnecessary steps. A flowchart shows how things should be done by comparing them to how they actually are.

EXAMPLE

SYMBOLS - CIRCLE ◯ = START AND FINISH

RECTANGLE ▭ = STEPS IN THE PROCESS

DIAMOND ◇ = DECISIONS TO BE MADE



HISTOGRAM

MEANING

'Histo" means story. "Gram" is a picture or graph. A histogram is a picture story that shows distribution of whatever is measured.

A histogram is a graph of data distribution.

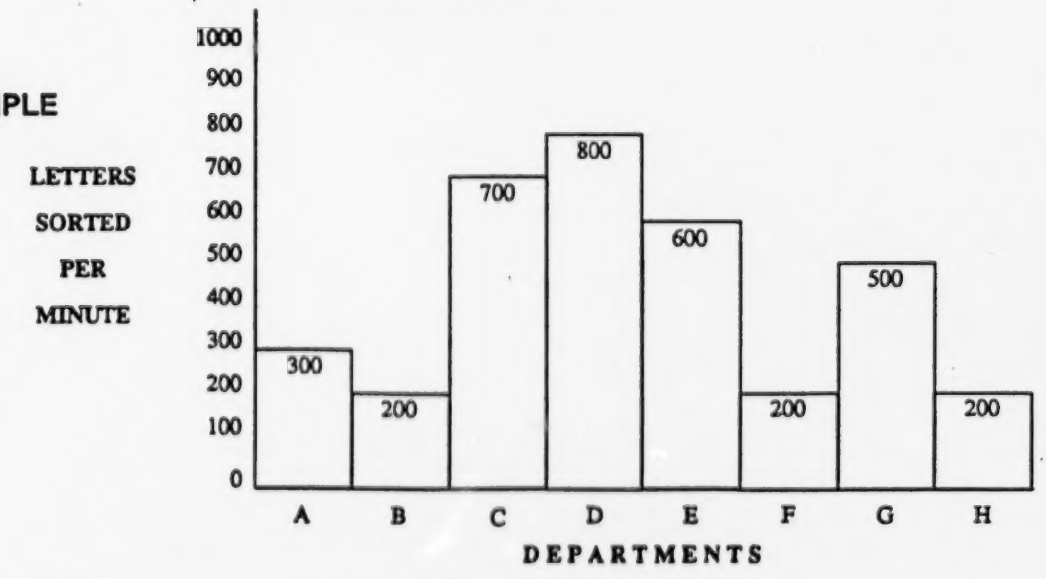
A histogram gives a clear picture of variations in data.

USAGE

A histogram shows measurements of categories and how they compare to each other.

A histogram shows where problems are when distribution is outside the desired controls.

EXAMPLE

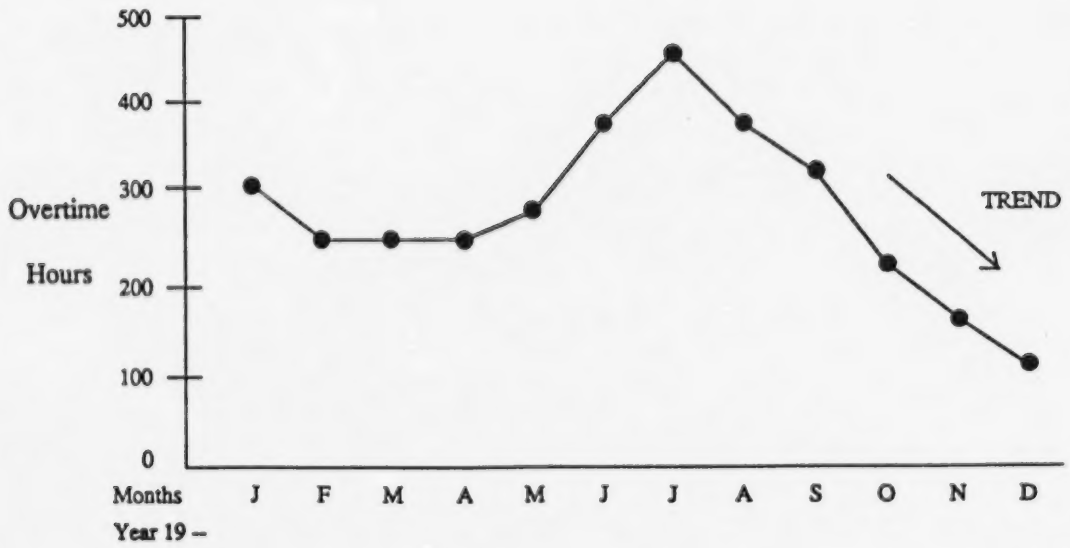


RUNCHART - TREND CHART

MEANING A graphic display of data gathered over time.

USAGE It checks measurements to detect changes in trends, shifts, or patterns over a period of time.

EXAMPLE

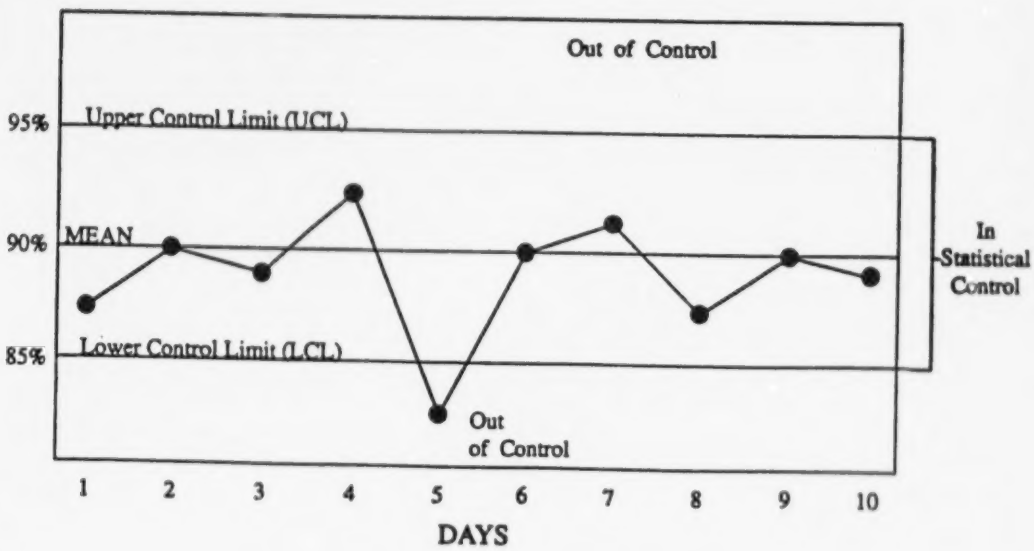


CONTROL CHART

MEANING A statistical tool that measures whether a process is "in" or "out" of control. A process is in control when all points are between the UCL and the LCL. Also see an example of a control chart on page 29.

USAGE It shows changes in the process by comparing the average with established upper control limits (UCL) and lower control limits ILCL).

EXAMPLE

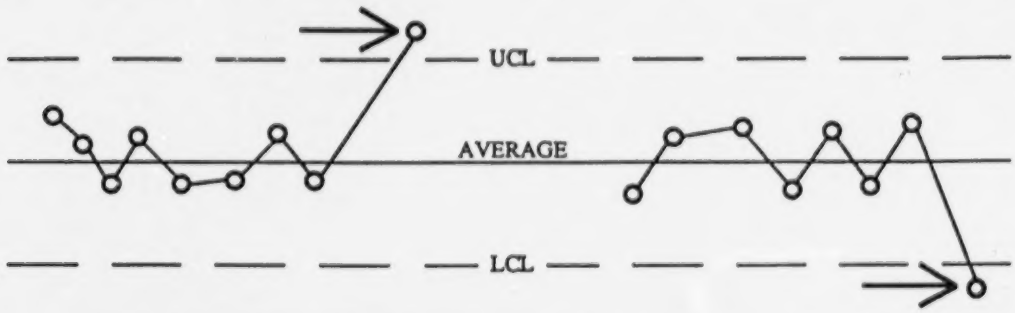


MORE ABOUT THE CONTROL CHART

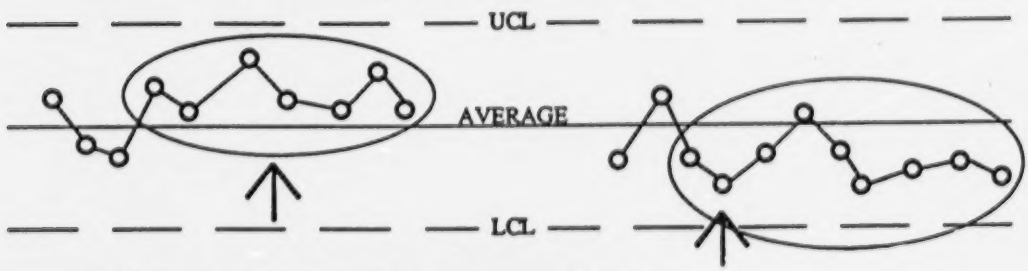
A control chart also shows variations, shifts, and trends.

EXAMPLES

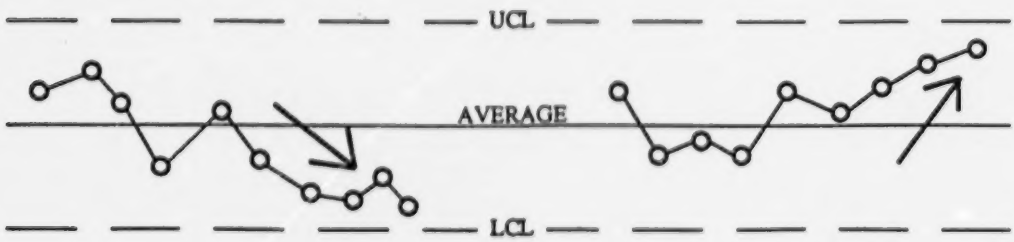
EXTREME VARIATIONS - CHANGE IN CONDITION



SHIFTS - CHANGE FROM ONE ARRANGEMENT TO ANOTHER



TRENDS - A STYLE TOWARD A CERTAIN DIRECTION



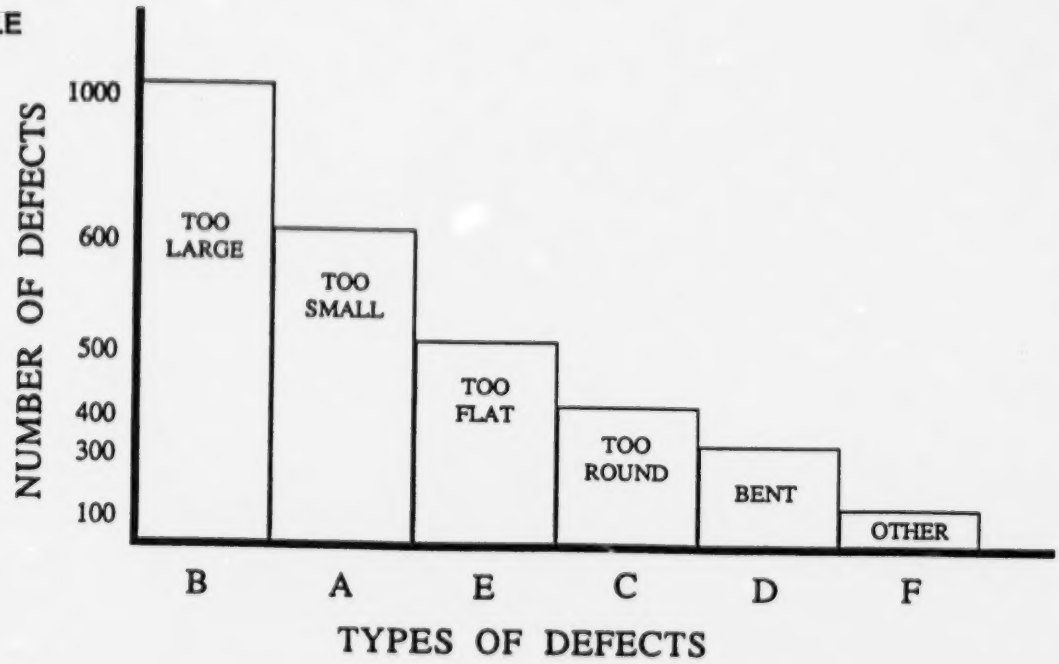
PARETO CHART

MEANING This tool is a series of lines or bars from left to right that rank problems in the order of their importance. The highest bar on the left represents the biggest problem.

The Pareto chart is the tool used to identify categories that account for most of the problems and the problem that gets the best feedback.

USAGE The Pareto chart helps determine the order in which problems should be solved.

EXAMPLE

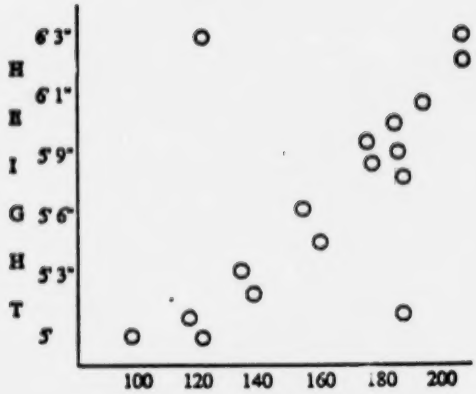


SCATTERGRAM - SCATTER DIAGRAM

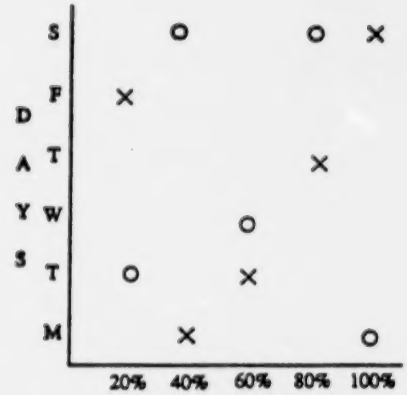
MEANING The scattergram is a tool that shows the relationship between two characteristics. The shape tells if the factors are related and shows the strength of that relationship. If one characteristic increases with the other, there is a close relationship. If characteristics are scattered, there is little relationship.

USAGE The scattergram is used to test possible cause and effect.

EXAMPLE



Weight and height are strongly related.



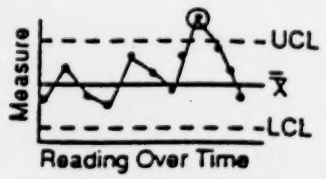
Salespersons
Bill X
Mary O

There is no connection between % of sales and days of the week.

A REVIEW OF STATISTICAL PROCESS CHARTS

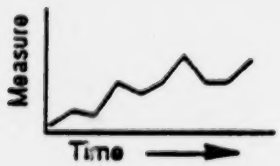
CONTROL CHART

SHOWS IF A PROCESS IS IN OR OUT OF CONTROL



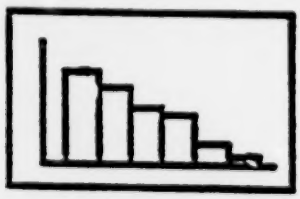
RUN CHART

SHOWS CHANGES IN TRENDS AND PATTERNS OVER A PERIOD OF TIME



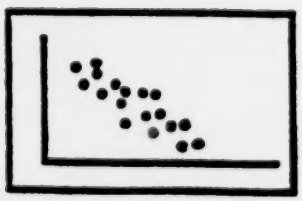
PARETO CHART

RANKS PROBLEMS IN ORDER OF THEIR IMPORTANCE



SCATTERGRAM

SHOWS THE RELATIONSHIP BETWEEN TWO FACTORS



CHECKLIST

SHOWS HOW OFTEN SOMETHING HAPPENS

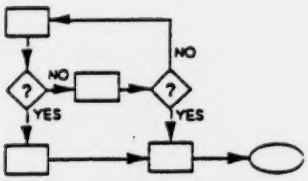
	1/2	1/3	1/4	Total
1	III	II	I	6
2	I	I	I	3
3	⧸⧸⧸⧸ I		II	7
4	I	II	III	6
5	I	I	⧸⧸⧸⧸	7

FISHBONE

SHOWS CAUSE AND EFFECT OF PROBLEMS

FLOW CHART

SHOWS STEPS IN A PROCESS OR PROJECT



HISTOGRAM

DISPLAYS VARIATIONS IN DATA

STEPS OF STATISTICAL PROCESS CONTROL

1. STUDY THE PROCESS

2. DEVELOP UNIFORM STANDARDS

3. DEVELOP AN ERROR-FREE PROCESS TO ELIMINATE AND PREVENT ERRORS

4. REDUCE CAUSES OF VARIATIONS

5. BRING VARIATIONS UNDER CONTROL

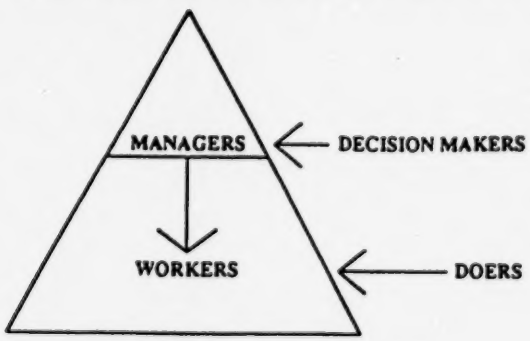
6. BEGIN ALL OVER AGAIN

TEAM BUILDING

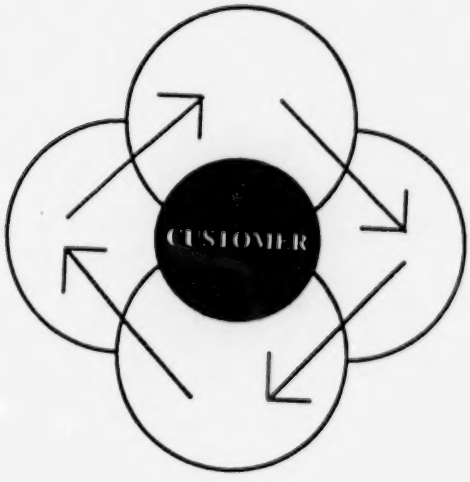
The first half of this book discussed the principles, concepts, and components of continuous quality improvement as well as the various types of statistical tools needed to gather scientific data to improve the working process. This section focuses on team building. Team building is the structure in which CQI issues are created, solved, analyzed, discussed, and improved.

To understand how team building works, it is helpful to review how a traditional organization functioned in the past. In the traditional model, management was fully in charge and responsible. Decisions and communication were made by managers at the top level and passed down to the employees at the lower level. Managers were the thinkers and workers were the doers. The full potential of all workers was rarely developed. The culture focused on profit, production, competition, conflict, fear, and powerlessness.

The boss or supervisor was responsible for production and kept tight controls over workers' behavior. Because emphasis was placed on production, workers worried about meeting quotas. This system bred competition, internal conflict, and fear of not measuring up. On the other hand, good work was rewarded with job security and promotions. The symbol for this type of structure was the pyramid.



Unlike the traditional model, the culture in team building focuses on quality, collaboration, trust, customer satisfaction, and job satisfaction. Teams help everyone in the organization to work cooperatively toward common goals. The role of managers is to free, influence, empower, and inspire workers to reach their full potential. The role of workers is to contribute his or her knowledge to improve quality. Managers and workers listen to one another. Customers are consulted about their needs. The symbol for team building is circular, where the satisfaction of the customer is central.



CHARACTERISTICS OF GOOD TEAM BUILDING

Some of the basic characteristics of team building are the following:

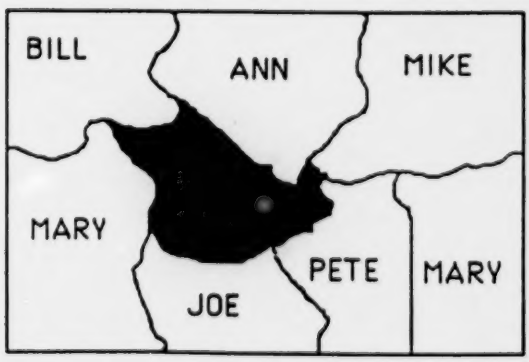
1. **Both managers and workers recognize team building as a way to receive new ideas and knowledge.**

2. **Members foster the attitude that people are the most important part of the organization, and that human resources are the most vital part of any organization's growth.**

3. **Team members must be qualified and selected because they have the expertise to get the job done.**

4. **Team work encourages interdependence among its members rather than dependence. Working together stimulates individuals to achieve better results.**

5. **Cooperation is needed for success. In a spirit of cooperation, people recognize the benefits of helping one another. No one person has all the answers, but each person has a piece of the puzzle. Once the pieces are shared, the larger picture is clear and possible solutions are easier.**



6. **Team members need to feel important and that they have something to contribute. Members claim ownership when they have a share in making decision, carrying out policies, or solving problems.**

7. **The responsibility for achieving (or not achieving) goal/s is mutually shared by all members. Because the performance of one member affects the performance of the whole, each member is accountable for and answerable to the rest of the team. To mutually share the work is to share the responsibility, the glory, and the success.**

8. **Members must trust and have confidence in one another. Trust is built when there is an atmosphere of honesty, fairness, sensitivity, and respect. A trusting environment empowers and frees people to be themselves. Trust helps members to feel comfortable enough to share their talents and reveal their opinions.**

A TEAM THAT IS COMMITTED TO THE TASK

AND MAKES FULL USE OF ITS MEMBERS' TALENTS

CAN ACHIEVE HIGH LEVELS OF PERFORMANCE.

GETTING STARTED

Initially, the team meets to decide how it will work together. Ground rules need to be established and agreed upon so all members have a clear idea about procedures. Issues that would be helpful to decide beforehand are:

1. Why does the team exist?
2. What is expected of each member?
3. How will team members relate to one another?
4. How will the team achieve its goals?
5. What decision making process will be used?
6. How will conflicts and disagreements be solved?
7. What is inappropriate behavior and how will it be solved?
8. How will the team evaluate itself?
9. How will time lines be met?
10. Who prepares, prioritizes, and circulates the agenda?
11. Who chairs the meetings? Do members alternate being chairperson?
12. Who records the minutes and circulates them to members?

STAGES OF TEAM DEVELOPMENT

Most teams pass through three stages of development.

INDIVIDUAL STAGE — People come together as individuals with self-centered interests. Members work independently and tend to be cautious. Conformity is more important than resolving conflicts.

GROUP STAGE — A group identity begins to emerge when members clarify roles and how they will work together. At this stage, the group tends to look for a leader who will give them directions and assign tasks.

TEAM STAGE Members become committed to equal sharing of responsibility. Members use goals to direct their decisions and actions. Communication is open and honest. Individual gifts are developed and utilized for the good of the whole. Members resolve conflicts or see them as opportunities for new ideas or constructive changes.

TRUST IS A PREREQUISITE FOR EFFECTIVE COMMUNICATION

The single most important aspect of team building is communication. Teams are formed for the purpose of accomplishing a given task, reaching a common goal, or making a specific decision. To do this effectively, team members need to communicate in an open, honest, and truthful manner.

Communication may be verbal or non-verbal. Verbal communication is an exchange of words from one person to another person who received it. It is a two-way street that requires both listening and speaking. Verbal communication also includes messages such as written letters, reports, agenda, or memos. Non-verbal communication, also called body language, is getting a message across without words. Whether communication is verbal or non-verbal, it must be clear and to the point. Effective communication just doesn't happen. It has to be developed, worked at, and maintained.

CONFLICT RESOLUTION

Because teams are made up of individuals, problems and conflicts are inevitable and part of a normal process. They can be positive or negative. Conflicts are positive when they generate new ideas, broaden the imagination, and lead to greater understanding of an issue or one another's thinking process. Conflicts are negative when they are avoided.

TYPICAL TEAM PROBLEMS AND THEIR SOLUTIONS

For people to work well on a team, it is good to know both desirable and undesirable behaviors. The chart below briefly explains some of the typical pitfalls that might cause conflicts and some possible solutions.

PROBLEM	POSSIBLE SOLUTION
Getting stuck	Determine what needs to be done and move forward.
Influencing, aggressive person	Elicit all team members' knowledge or point of view.
Dominating, monopolizing person	Structure the meeting so all can be heard. Kindly tell person that others need to be heard.
Stating opinion as facts	Ask for data to prove statements.
Judging	Avoid giving motive for another's action. Adhere to observable facts.

Rushing	Pace time adequately.
Discrediting, discounting	Give credit and praise when due.
Socializing	Provide break times to socialize.
Wandering	Name a member to keep group on target. Stay with one subject till solved.
Accommodating, non asserting	Encourage person to challenge members.
Non-participating, quiet member	Encourage participation. Never assume silence is consent.

As teams should include qualified persons to get the job done, there are also different types of personalities who would add to the success of team development. Consider the following types?

PERSONALITIES	CONTRIBUTION TO TEAM EFFORTS
Initiator	Helps get things moving.
Facilitator/Leader	Makes sure all members share ideas honestly and openly.
Motivator	Encourages participation, supports members to reach full potential.
Harmonizer	Helps relationships when things get tense.
Analyzer	Evaluates team's actions and keeps members focused.
Negotiator	Brings settlement or resolve to issues.
Organizer/Designer	Arranges matters and ideas in correct order.
Implementor	Puts words or projects into action.

Researcher	**Gets the facts.**
Summarizer	**Makes a brief restatement of what was spoken and checks for agreement.**
Shaper/Designer	**Develops and gives form to projects.**

CONSTRUCTIVE FEEDBACK

For a team to grow and develop, it must have constructive and honest feedback. Feedback is the return of information about an activity. Both negative and positive feedback have value. If there is agreement and commitment to giving honest feedback, it should be no surprise when it is given or received.

Constructive feedback should be given at the appropriate time and with care. Relate the feedback to a specific event and with correct facts. Use "'I" instead of "you". "You" reflects finger pointing. People become defensive and won't hear what is said. Here is a formula and example of constructive feedback:

1.	WHEN YOU...	"When you are late,
2.	I FEEL...	I feel a lot of time is wasted
3.	BECAUSE...	because we have to repeat ourselves.

(GIVE THE PERSON A CHANCE TO RESPOND.)

4.	I'D LIKE...	I'd like you to be on time so we can do more,
5.	IF THAT IS AGREEABLE TO YOU...	if that is agreeable to you. What do you think?

RESPONDING TO NEGATIVE FEEDBACK

Sometimes feedback in not always given with the best of care. When this happens, it is helpful to know how to react.

1. BREATH DEEPLY TO ALLOW YOUR BODY TIME TO RELAX AND KEEP YOUR MIND ALERT.

2. LISTEN TO WHAT IS SAID. THEN ASK QUESTIONS FOR CLARIFICATION.

   If time is needed to think over the situation, set a later time to respond.

3. PHRASE THE FEEDBACK IN YOUR OWN WORDS TO BE SURE YOU HEARD IT CORRECTLY.

4. AGREE WITH WHAT IS TRUE OR POSSIBLE.

   Behavior may not necessarily change. The person may continue to be late and have no way to be on time.

Feedback does not always have to be about negative points. Giving a compliment is also constructive feedback. There is nothing better to generate good morale and spirit than praising others for their good work. Praise benefits the giver as well as the receiver.

TEAM EVALUATION

No team is perfect or without its problems. Therefore, it is essential to take time periodically to evaluate how things are moving along. The purpose of an evaluation is not to point fingers, but to determine how the team might improve. There are some basic questions to ask when evaluating the team's progress:

1. Is the goal of the team clear and commonly understood?
2. Are roles clearly defined?
3. Is communication open and honest.?
4. Does everyone attend meetings and arrive on time?
5. Do all team members participate?
6. Are tasks equally shared and completed on time?
7. Are members respectful of one another, particularly in disagreements?
8. Are accurate records kept?
9. Are problems faced and solved immediately?
10. Is every member knowledgeable on how the team process works?
11. Do all members know how decisions are made?
12. Does the team rely on good data and accurate information to make decisions?
13. Once the goal or decision is made, is there an implementation plan?

BRAINSTORMING

An important technique used by teams to draw on the creativity of its members in a short amount of time is brainstorming. Some basic rules regarding brainstorming are:

1. Encourage each member to participate freely and not hold back.
2. Think as though money is not a barrier.
3. Piggy-backing on others' ideas is encouraged. Repetition is acceptable.
4. Be comfortable with moments of silence. It fosters new ideas.
5. Adopt the attitude that no idea is outrageous or impractical. An unconventional idea may end up being the right one.
6. Make no judgments, positively or negatively.
7. Leave all discussion for a later time.

PROCEDURES

Some procedures for brainstorming are:

1. Identify ideas by asking who, what, where, when, why, and how questions.
2. Give team members a few minutes to think about the topic.

3. Invite each member to briefly share ideas either formally (in rotation with the option to pass) or informally by calling out ideas.
4. Ideas should be recorded and numbered on a chart.
5. Conclude brainstorming when all ideas are exhausted.

Once ideas are generated, narrow the list down to a few good items. Combine similar ideas. Discuss remaining ideas. Discussion is the most time consuming part of team work. To break any deadlock, use the voting or consensus process. Voting is a formal choice expressed by a show of hands. To reach consensus requires a general agreement from all members. Some may not be entirely satisfied with the group's choice, but they agree to go along with it. When the team agrees on the BEST solution, it is ready to be implemented.

Once teams are established and running, the primary responsibililty of the members is to solve problems that disrupt quality performance. In summary:

1. The CQI philosophy provides the positive culture for quality improvement to work.

2. Teams provide the structure where quality issues are addressed.

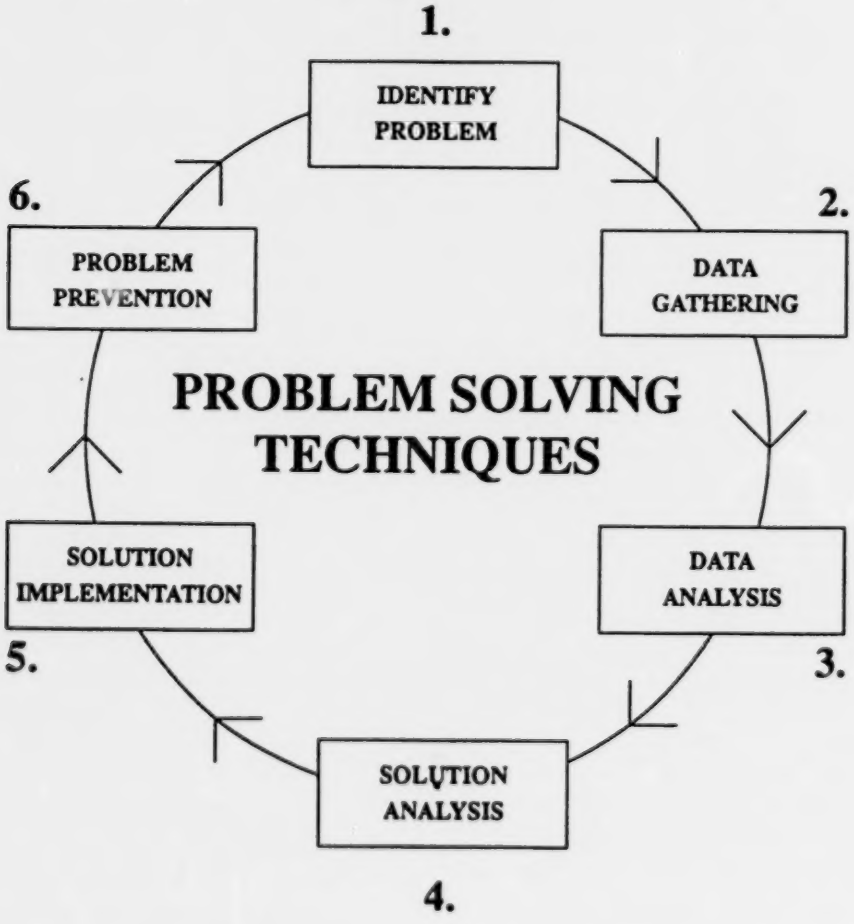
3. SPC provides the tools to gather scientific data to analyze quality performance.

4. The final step is to implement problem solving techniques. The chapter that follows explains six techniques used in problem solving.

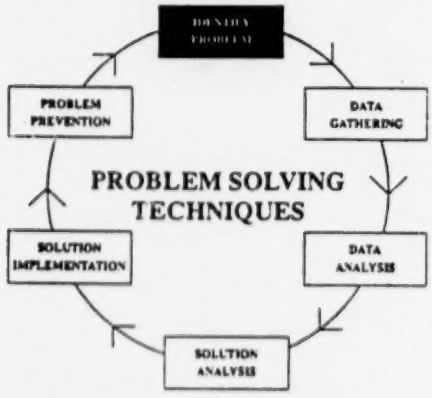
PROBLEM SOLVING

A problem is a doubtful, uncertain, difficult, or conflicting situation that requires an answer, decision, or solution. Problem solving or decision making is the act of deciding the BEST solution out of many possible ones.

Problem solving is an art and like any art, it becomes better with practice. No one makes perfect decisions all the time. Developing problem solving skills help increase one's decision-making ability and avoid mistakes that are costly in time and production. Good problem solving techniques promote quality work. Consider the following techniques when solving problems.



STEP ONE - IDENTIFY THE PROBLEM



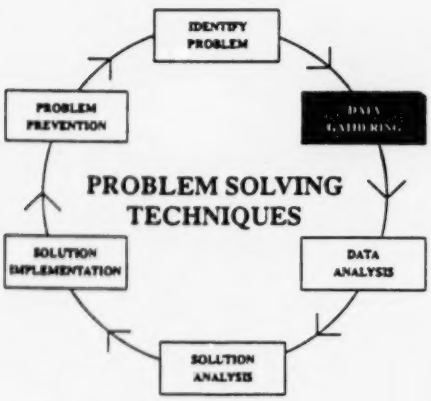
A problem can't be solved if it is unknown. Consequently, the first step in solving a problem is to accurately identify what it is. There are two basic mistakes made that cause problem solving to be difficult. The first is that problems are often described in vague statments. To solve a problem, the problem must be clearly identified. Examples of vague and unclear statements follow:

VAGUE STATEMENTS	CLEAR STATEMENTS
The television is broken.	The TV has no picture.
Turn the switch.	Turn the On Switch to the right.
Absenteeism is a business problem.	There are 10 people absent three or more days with no explanation.
I have little money available now.	I have poor spending habits.
I can't tape the basketball game.	My VCR won't record.

I'm late for work a lot.	I am five to ten minutes late every Friday.
My son can't go to college this year.	My son lost the summer job that would have paid his college tuition.
Mary failed her math exam.	Mary failed her math exam because she didn't know fractions.

The second common mistake people make is to think the symptom of the problem is the problem itself. The symptom is a sign or indication that a problem exists, but may not necessarily be the actual problem. For example, smoke is a symbol of fire. The smoke is not the problem, however, the fire is. Once the problem is identified, determine if the problem will solve itself. Sometimes the best decision is to do nothing. If the problem requires action, do it immediately.

STEP TWO - DATA GATHERING



This step is called the research phase. Research is looking into a subject for the purpose of discovering and checking the facts. The more information gathered about a problem, the easier it is to solve. A simple rule to follow is to gather enough information to see the whole picture.

Problems are both simple and complex. Simple problems may be easily solved by drawing on experience, intuition, and knowledge. For more complex problems, there are many valuable resources available. Resources include experts with knowledge in particular fields, books, tapes, maps, videos, and written records. Libraries, schools, and businesses are places where information is stored. An educated person is not one who knows everything, but someone who knows the resources to consult in order to get needed information.

Three helpful suggestions to keep in mind during the second step are:

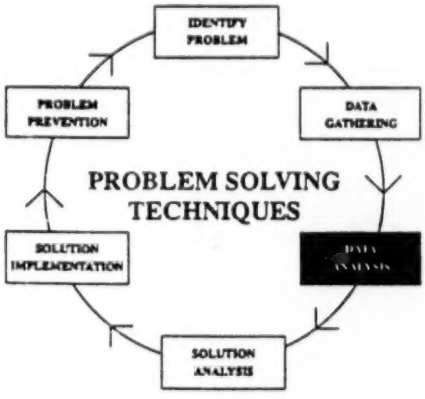
1. Be open to anything and everything that comes to mind. The answer or solution may be something different or unexpected.

2. When sufficient information is obtained, organize and integrate it into a statistical tool that presents a total picture in one glance.

3. To avoid being overwhelmed by the amount of information, remember that a problem can be broken down into smaller steps and taken one at a time.

4. A trap people fall into at this point in the problem solving process is to try to analyze the problem. The main purpose of step two is to gather data.

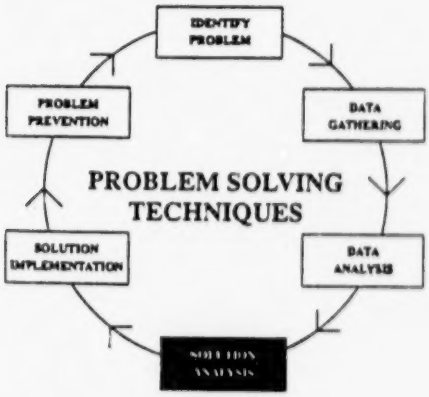
STEP THREE - DATA ANALYSIS



The purpose of the third step is to analyze data gathered by comparing it to what is normal or expected. Problem solvers examine the information in order to determine possible solutions. This step is referred to as the cause and effect stage. The cause is the result of why something happened. The effect is the end result. The following chart illustrates this concept with actual problems.

PROBLEM	CAUSE (WHY)	EFFECT (RESULT)
Late for work every Friday.	Had to drive son to day care.	Written warning in personnel file.
Machine broke down.	Safety belt was weak.	A loss of $3,000 in production.
High rate of absenteeism.	Low morale among staff.	10% decrease in production.
Manual too difficult to read.	Poor reading comprehension.	Excessive errors.

STEP FOUR - ANALYZE SOLUTION



Deciding what to do about the problem takes place in this step. Analytical skills are used to weight EACH possible solution and see how it compares with the others. Making a decision is a rather simple step, but making the BEST decision requires some thought. To arrive at the BEST decision, ask some basic questions about each solution.

1. What would happen if...?
2. What are the cold hard facts about this decision?
3. Is one solution more effective than another?
4. What is the time factor involved in this solution?
5. Does the action address the problem or is it only a bandage?
6. Does this solution create more problems than it solves?
7. If the solution involves money, is it affordable?

Be creative in brainstorming all possible solutions. When evaluating possible solutions, new ideas may surface. The solution might be a combination of two solutions joined into one. Be realistic about each solution to the problem. Make sure it can be achieved.

In the chart below, two possible solutions are given for the previously mentioned problems. In the fourth step, each one is evaluated. Out of all the solutions presented, the BEST one is chosen. Once the solution is determined, it is ready to be implemented.

PROBLEM	CAUSE (WHY)	EFFECT (RESULT)	SOLUTIONS
Late for work every Friday.	Had to drive son to day care.	Written warning in personnel file.	. Have someone else drive son. . Drive son earlier.
Machine broke down.	Safety belt was weak.	A loss of $3,000 in production.	. Buy a stronger belt. . Get a new machine.
High rate of absenteeism.	Low morale among staff.	10% decrease in productin.	. Establish worker incentives. . Recognize good attendance.
Manual too difficult to read.	Poor reading comprehension.	Excessive errors.	. Provide reading classes. . Rewrite manual.

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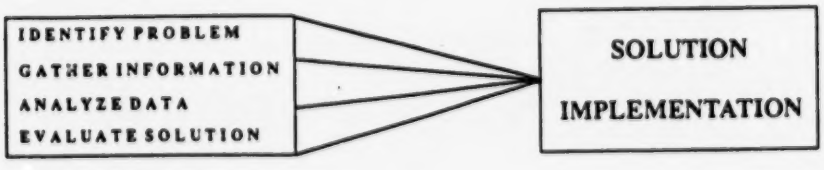
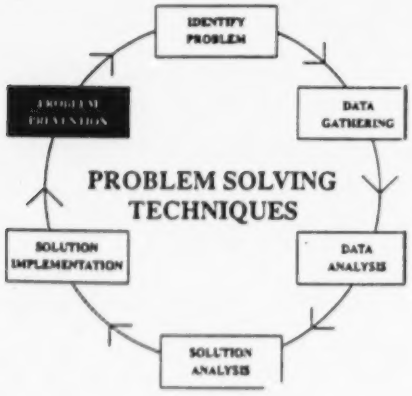
STEP FIVE - SOLUTION IMPLEMENTATION

Once a decision is made, it must be implemented. Implementation is putting the solution into action, otherwise the decision is worthless. Problem solving steps one through four merge at this point. The best way to secure successful implementation is to include many others in the process. People are more apt to co-operate if they have input and can understand what is taking place



STEP SIX - PROBLEM PREVENTION



A step is needed to ensure that the solution takes care of the problem. Therefore, the last step is called problem prevention. Continual review of the solution ensures more firmly that the problem won't happen again. Consider the following questions:

1. How do you know the solution is working?
2. How do you know the problem is fixed or will stay fixed?
3. How do you know the problem won't happen again?

If the problem isn't fixed or solved, the whole process from steps one through six have to be repeated.

ISO 9000

In 1987, the International Standards Organization (ISO) developed quality standards of excellence that would be recognized and accepted throughout the world. Over 35 countries use these standards. Included among them are many European nations, Australia, New Zealand, Canada, China, India, South Africa, and the United States.

ISO 9000 standards certify a company's ability to sell directly to other countries without additional inspection. Consequently, firms that meet the ISO 9000 standards have a competitive edge in the European market over those who don't. To apply for certification, a firm invites accredited ISO auditors to visit their facility to determine if it meets ISO standards. There are broad categories in the ISO 9000 standards:

ISO 9001	Engineering/Construction-Type Firms and Manufacturers
ISO 9002	Chemical and Process Industries
ISO 9003	Small Shops or Divisions that Inspect and Test Products
ISO 9004	Quality Management and Quality Systems Guidelines

DEMING PRIZE

Japanese companies started a yearly competitive prize that rewards any business or organization that effectively implements CQI management principles. Japan is a country that highly respected teachers, so they named the prize after their teacher, Dr. W. Edward Deming.

THE MALCOLM BALDRIGE AWARD

The Malcolm Baldrige National Quality Award began in 1987 by an act of the U.S. Congress. Two awards are given each year in three categories: manufacturing, service, and small business.

The disadvantage to seeking the Baldrige Award is that it is an expensive and involved procedure. Seven general areas are closely examined and awarded point value:

1.	Leadership	90 Points
2.	Information and Analysis	80 Points
3.	Strategic Quality Planning	60 Points
4.	Human Resource Development and Management	150 Points
5.	Management of Process Quality	140 Points
6.	Quality and Operational Results	180 points
7.	Customer Focus and Satisfaction	300 Points

These seven areas are further divided into smaller items. If the efforts to achieve the Baldrige Award is an active, continuous commitment to CQI, the payback is well worth the expense.

The development and printing of this textbook, *Quality Assurance Made Easy*, was made possible by a grant from the U.S. Department of Education through the National Workplace Literacy Program.

A *Quality Assurance Reading Comprehension Workbook* accompanies this text and contains exercises on seven basic reading skills: locating the answer, detecting the sequence, following directions, getting the main idea, drawing conclusions, following directions, and getting the facts.